Developing the Next Generation of Energy Efficiency

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What Type of Energy Efficiency (EE) Are We Discussing?

- Stationary related uses of energy
  - Not transportation – though federal CAFE standards have been very significant in saving energy in cars and light trucks
- Residential and commercial energy use, focusing on buildings
- Focused on large-scale mobilization and delivery

The "Next Generation of Energy Efficiency" Initiative

Goal: Develop a new framework to mobilize and deliver non-transportation energy efficiency savings, at a level far beyond historical practice, for the commercial and residential sectors that: 1) provides persistent greenhouse gas emission reductions and 2) optimizes planning and operation of an electric grid with very high levels of intermittent renewable resources, including distributed generation, and increasing levels of transportation electrification and storage.

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Current Focus

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Changing Role

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What Are the New Tools?

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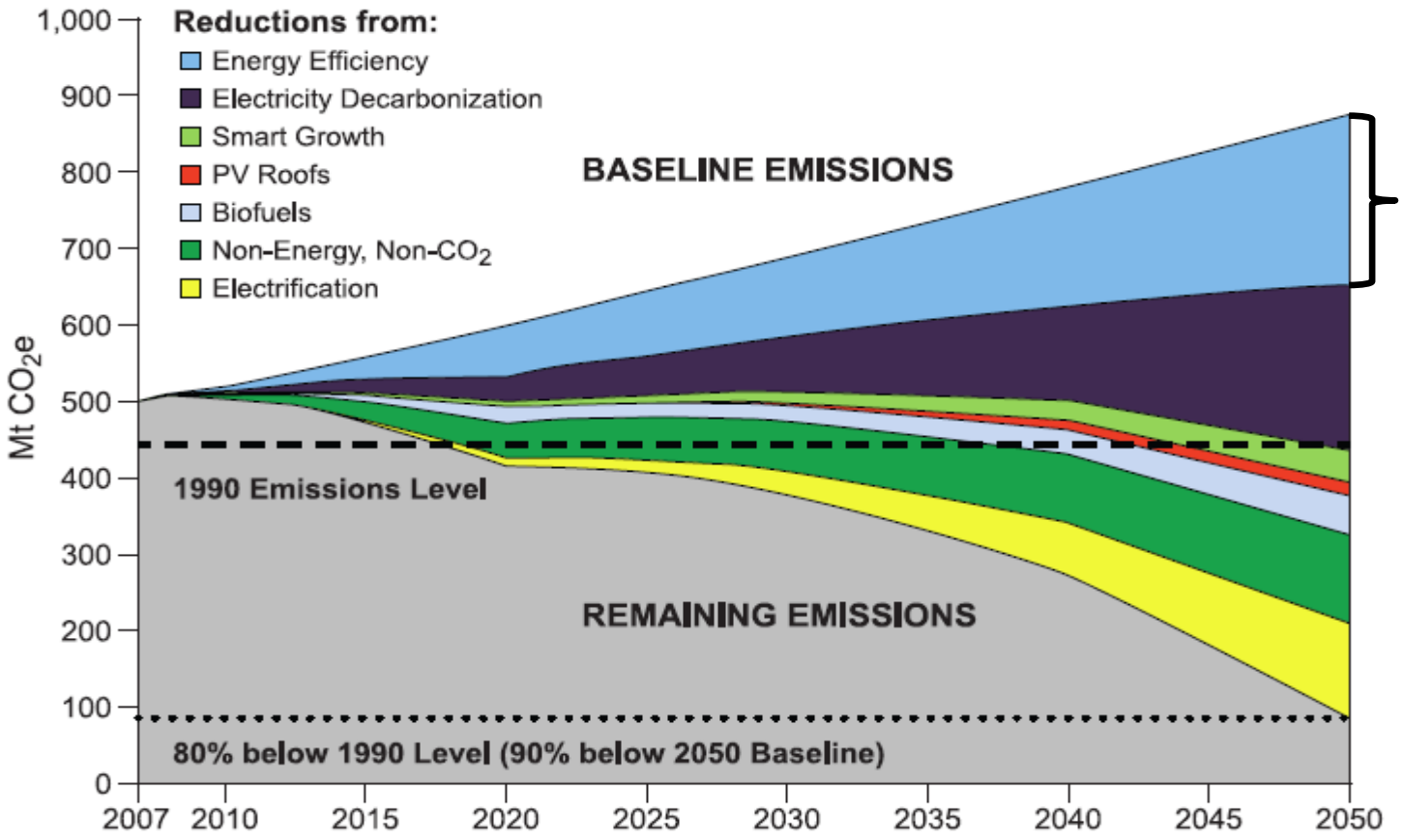
Overview

- Why is a new EE framework needed?
- Next generation of EE research areas
  - EE's historical role and results
  - EE's changing role and scope
  - A new framework
  - New regulatory models
  - Enhanced evaluation, measurement, and verification
- How to learn more and be involved

Why Is a New EE Framework Needed? California Example



Requires **1.3%** compounded annually – 2.6x CA's historically delivered savings

Source: Jim Williams et al. "The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity": Science 2012

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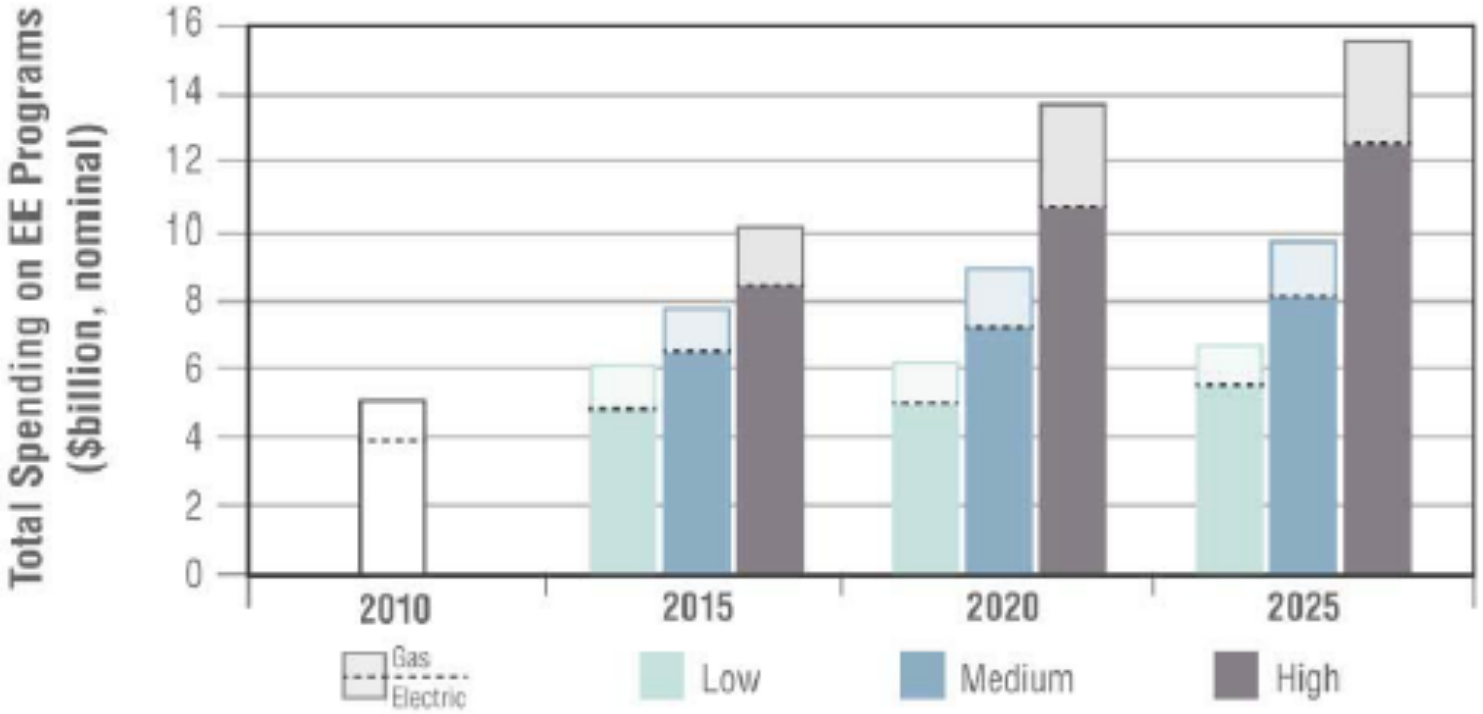
U.S. Customer-Funded Projected EE Spending



Source: LBNL: "The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025" (January 2013)

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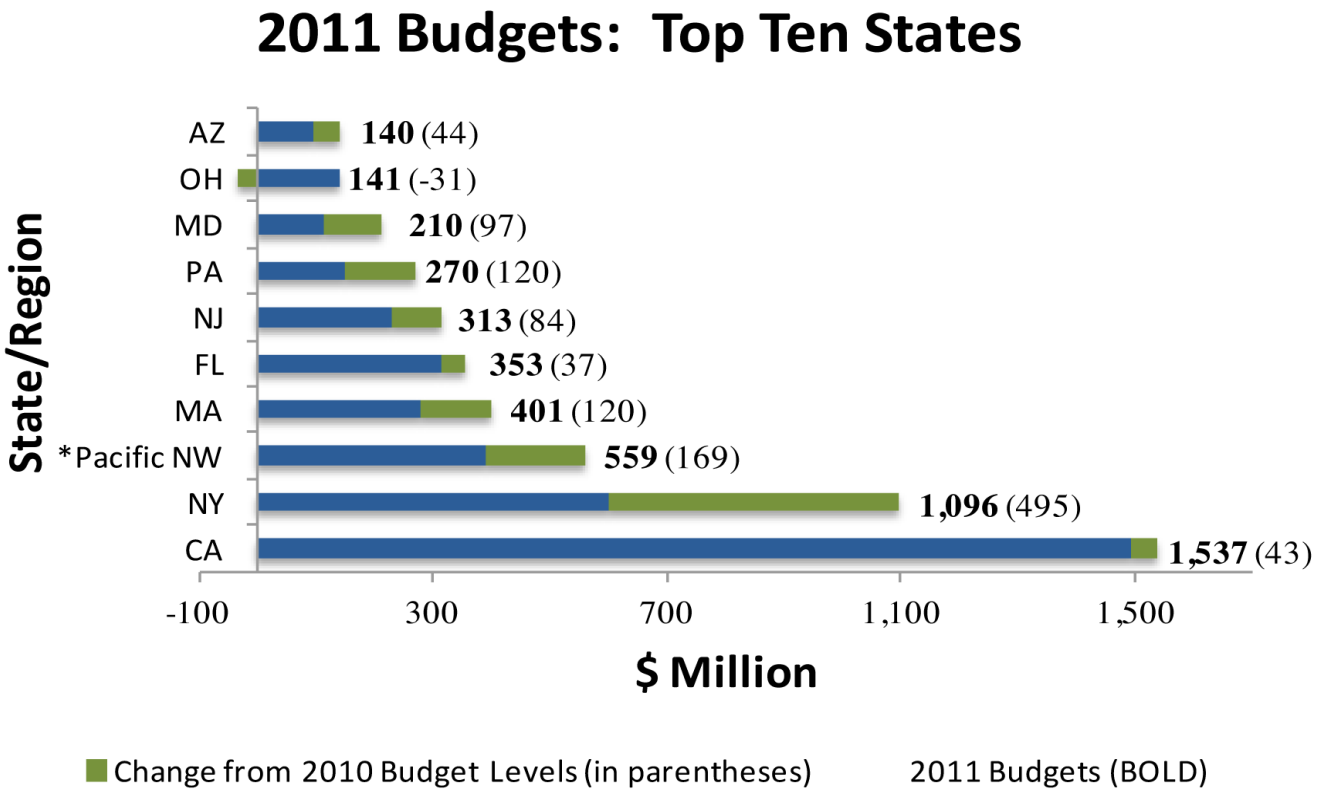
Calif. Program Is By Far the Biggest



Source: "Consortium for Energy Efficiency Survey" (2011), as found in "Summary of Ratepayer-Funded Electricity Impacts, Budgets, and Expenditures" (IEE Brief, January 2012)

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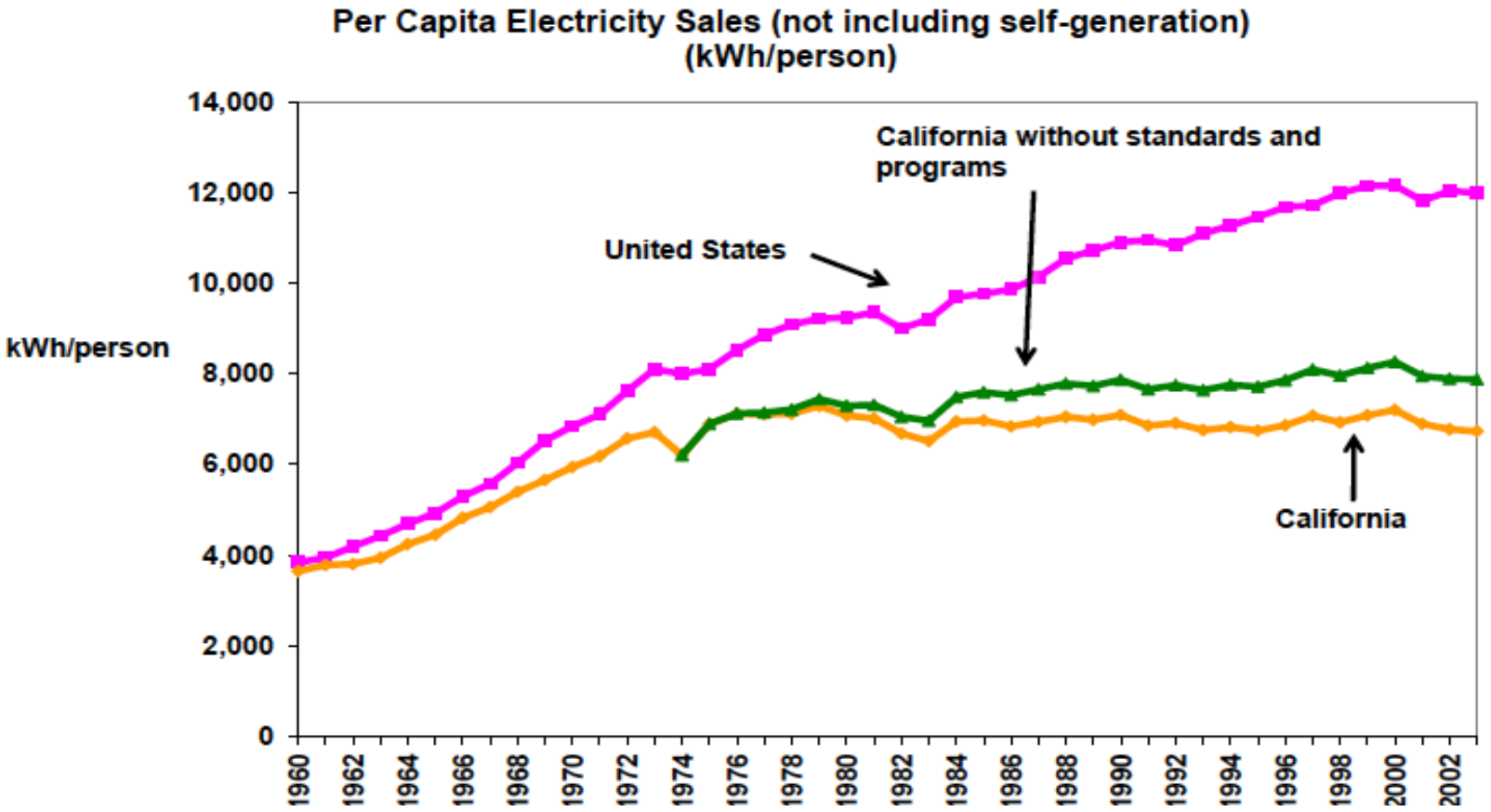
Historical EE Savings in CA
(Non-Transportation)



Source: CPUC

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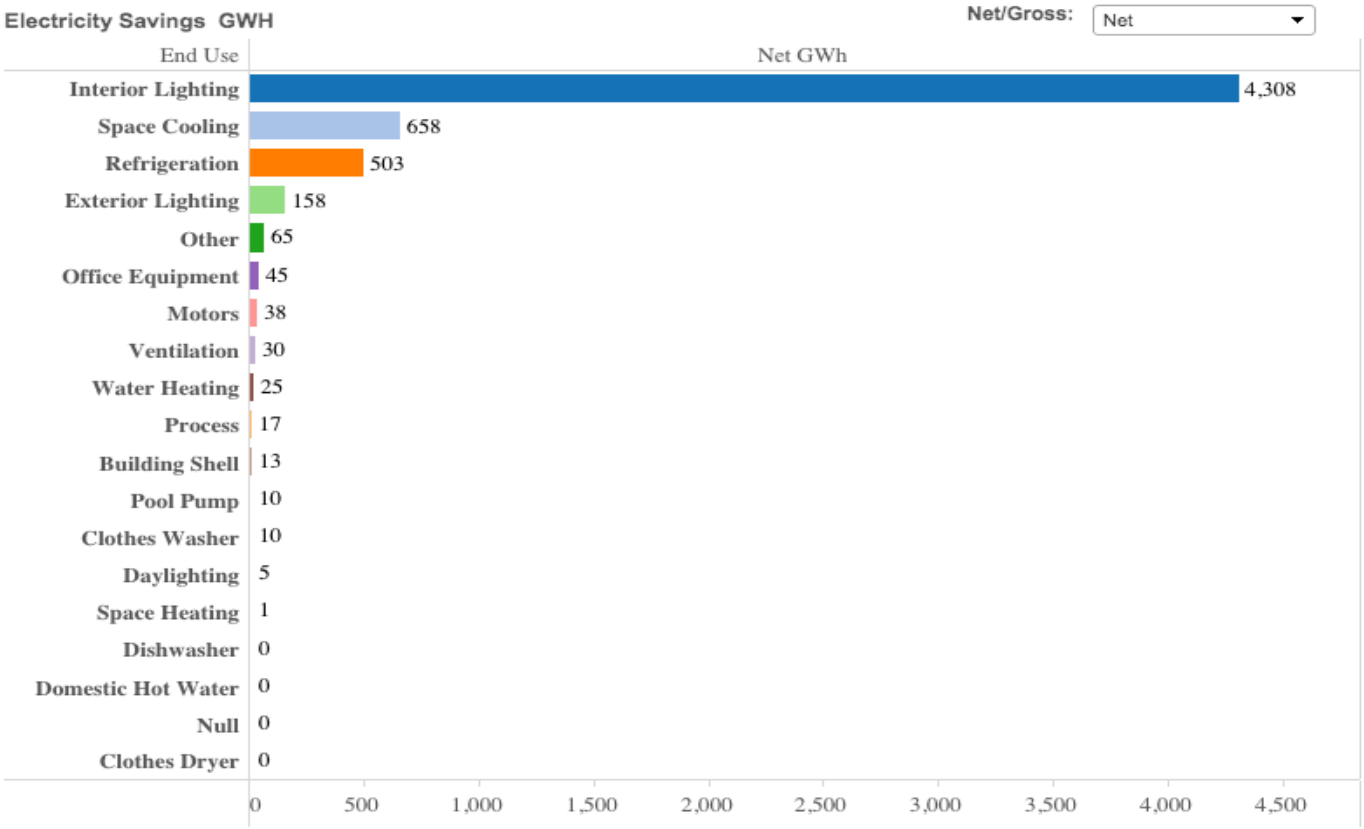
Most EE Savings (Non-Transportation) Comes from Lighting



Source: CPUC EE Data Portal (Data from 2010-2012 program cycle)

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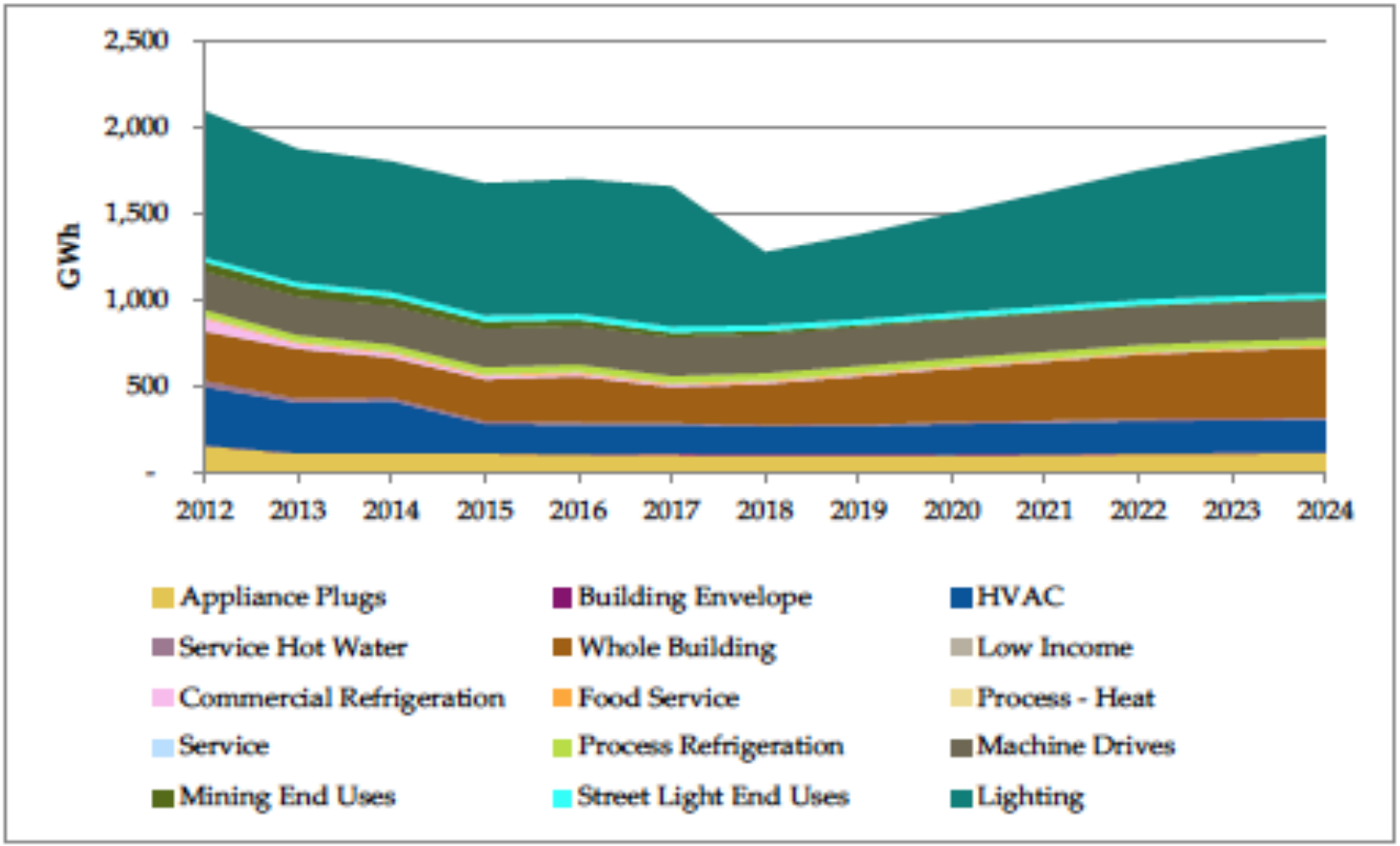
But, Wait, There's More to Do!



2013 Cumulative results exclude C&S savings and behavioral savings.

Source: Navigant, 2013 CA EE Potential and Goals Study

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Limitations of the Current (Non-Transportation) EE Framework

- Based on a framework developed 30 years ago that is "widget based," highly regulated and does not support "whole building" solutions
- Focused on energy savings and costs, not sustained reduction of GHG emissions or the evolving grid
- Limited attention to:
  - Leveraging of private sector financing and delivery
  - Support for innovation
- Evaluation, measurement, and verification of results uneven (and disputed)
- Primarily delivered through a public policy/regulatory framework, which is fragmented in its development, implementation, assessment and oversight

Bringing Us to…

Stanford University's

Next Generation Of Energy Efficiency

Initiative

A vision for widespread mobilization and delivery of energy efficiency through 2050

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Research Area 1:

EE's Historical Role and Results

What has worked/not worked
in historical EE efforts in terms of:

- Carbon emission reductions
- Persistency of savings
- Scalability/market share
- Market transformation
- Other factors?

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Research Area 2:

The Changing Role and Scope of EE

Role #1: Focus on avoided GHG emissions

Role #2: Fitting within an integrated demand side management framework and a supply system with high levels of renewables/intermittency/ transportation electrification

Need for large-scale participation, as well as faster, more comprehensive and persistent savings

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Research Area 3:

Developing A New Framework

Climate driven, supporting innovation and new technologies, and optimizing grid planning and operations

- Focus: mobilization and delivery
- What does the commercial and residential end use market look like between now and 2050, and how do we maximize savings and value?

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Research Area 3:

Developing A New Framework (cont'd)

Leveraging opportunities across three key areas:

- Data and analytics (databases, benchmarking, interval meters, software, advanced controls, etc.)
- Behavior change/social decision-making
- Driving private sector investment (profit matters)

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Research Area 4:

New Regulatory Models

- Market information and transparency
- Linked to GHG goals (111d) and development of new grid
- Policies and incentives – beyond decoupling
- Program administrators and implementers – how to incent and measure performance
- Enhancing role of codes and standards
- Regulatory agencies (PUCs, air quality regulators, energy offices) – limited staffs, coordination across agencies, what roles are needed?

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Research Area 5:

Enhanced Evaluation, Measurement & Verification (EM&V)

- What results do we want to measure and why?
- What is the role of cost-effectiveness tests (for our 2050 goal)?
- What are better EM&V methodologies, esp. using new tools (e.g., data analytics)

Ending Observations

- Critical area – climate, grid stability and affordability
- New and unexplored areas
- Solutions will be interdisciplinary, detailed and holistic
- Creative thinking and rigorous analysis welcome

How to Learn More and Be Involved

- If you are interested in contributing to this project or want to be kept informed, contact:
  - Dian Grueneich, dgruenei@stanford.edu
- Starting Winter Quarter (January 2015), PEEC will host an informal discussion group open to Stanford faculty, staff, and students to discuss ongoing research
- Project will also include non-Stanford stakeholders – policymakers, companies, utilities, investors, local governments, etc.

Appendix
Additional Slides

Research Area 3: A New Framework

- What new delivery approaches will support EE delivery in a more market-oriented fashion?
  - Example: Competitive procurement of EE based on avoided GHG emissions, using 10-20 year payment stream
  - Example: Reduction of EE uncertainty by databases with measured energy consumption
- Can new methodologies be developed that measure and award performance of whole systems (such as buildings)?
  - Example: Whole building efficiency approaches that value building productivity and not just occupancy (or lack thereof)
    - Q: What is the role of an efficient building in 2040 vis a vis transportation?
- How to reward EE that provides value in systems with >60% distributed generation and renewables?
  - Example: EE payments based on location and timing of savings (not just demand response); development of new EE technologies that mesh with grid

Research Area 3: A New Framework (cont'd)

- Can analytics enhance building codes development and compliance?
  - Increasing focus on codes & standards to deliver EE savings and GHG emission reduction goals
  - Staggering rates of non-compliance (up to 100%)
  - CA Title 24 compliance estimated as high as 113% and as low as 8%, depending on measure
  - What should the next 30 years of code development/ compliance look like?

Research Area 3: A New Framework (cont'd)

- How can efficiency and carbon savings be maximized through behavior change in an expanded EE framework?
- Up to 10 times more private investment for EE is needed going forward – how can this investment be accelerated through focus on profit opportunities, esp. at the non-federal level?
- How can a new framework consistently support market transformation/innovation and not just lowest cost?